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Operational Implementation of a Validated Personnel Selection  
System for Landing Craft Air Cushion (LCAC) Vehicle Operators

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Abstract

To support the performance-based selection of LCAC operators, we identified and evaluated a battery of personality, cognitive, and psychomotor tests at the Naval Aerospace Medical Research Laboratory. Operational testing of LCAC candidates for selection into training began in May, 1990. Results indicate that several tests are predictive of LCAC training criteria. Fifty LCAC candidates took the test battery as a requirement for entry into the LCAC training program. We collected and analyzed training performance data from those candidates that achieved a passing score on the LCAC test battery. Descriptive statistics and correlation coefficients were derived. Psychomotor test performance demonstrated a significant relationship with the LCAC performance criteria. Results indicate that the use of computer-based testing yields a selection success rate of 96% for LCAC operators completing training. The implications of these findings for LCAC personnel selection are discussed.

Introduction

One of the world's most unique transport vehicles is the Landing Craft Air Cushion (LCAC) vehicle. The LCAC "rides" on a cushion of air generated by large fans that allow it to negotiate both land and water surfaces. The LCAC is similar to a helicopter in that it has six dimensions of motion. Operating the LCAC demands unique perceptual and psychomotor skills. In addition, with a machine as expensive and inherently dangerous as the LCAC, sound judgment and decision-making play an important role.

As training costs escalate and projected plans call for an increased number of LCAC vehicles and crews, selecting candidates who will be successful in the operation of complex machinery becomes more critical. In 1988, the Naval Aerospace Medical Research Laboratory (NAMRL) completed the development of a computer-based performance assessment battery for LCAC. This automated battery assesses basic information processing abilities,

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higher order processes, psychomotor skills, time-sharing ability, and personality traits that might predict success in LCAC training. The test battery was based on previous literature and research from pilot selection, e.g., Damos and Gibb (1987); Dolgin and Gibb (1989). A recent report based on an aviator selection model (Blower and Dolgin, 1991) supports the efficacy of computer-based assessment in selection.

A concurrent validity study examining Navy fleet LCAC operator performance on the automated test battery was reported recently (Nontasak, et al. 1990). In those studies, several predictor tests were significantly correlated with measures of success in LCAC training. The reports contain the results of an initial predictive validation of the test battery for LCAC trainees. Descriptive statistics and individual correlations between test measures and LCAC training criteria are presented.

The criterion measure used was pass or fail in LCAC primary training. The underway grade (UG) is the core criterion and represents a composite score reflecting a student's tactical performance in the training hovercraft. We did not relate test battery measures to specific components of LCAC training. Past research in flight training has shown the difficulty of identifying reliable subcriteria embedded within the more global criteria (Dolgin, et al. 1987).

#### METHODS

##### Subjects

Prospective LCAC operator candidates ( $N = 50$ ) were selected for training on the basis of current medical examinations and NAMRL computer-based testing results. The operator candidates were informed prior to testing that the results would be used in the final selection decision. The candidates were 20 to 42 years old ( $M = 31.19$ ,  $SD = 5.93$ ). All candidates were male and had successfully completed a minimum of a high school education.

##### Apparatus

All testing was conducted on Apple IIe microcomputers with control sticks, foot pedals, and throttle. Subjects used a numeric keypad to respond to discrete stimuli. All responses were recorded to millisecond accuracy. For psychomotor tests (PMT), two control sticks (Measurement Systems, Inc., 542) were used for cursor control during the tracking tasks. One control stick was mounted in the center on the forward edge of a standard straight-back metal chair. The other stick (throttle) was mounted on the left edge of the chair. Additional apparatus included rudder pedals patterned after those of a Systems Research Laboratory psychomotor test device. Two Jameco JE 520-AP Voice Synthesizers were used to present the Dichotic Listening (DLT) letter-digit strings over binaural headphones. Further details are included in Blower and Dolgin (1991).

### Procedure

All subjects were tested prior to entering LCAC training. Instructions were presented to the subjects on the CRT for each task. Test administrators intervened only to begin the computer program for each task and to answer questions posed by subjects at any time. The test battery took from 2.15 to 2.30 h to administer with a 3-4 min rest period given after each task.

### Results

#### Psychomotor Task and Dichotic Listening Task

Performance on the series of psychomotor multitask conditions correlated with training criteria. Table 1 lists the tests that correlated significantly with training criteria. When performed in combination with the DLT, PMT tasks indicated a high relationship to UG with coefficients ranging from -.54 to -.60. These correlations were in the expected direction. That is, greater psychomotor tracking error was associated with lower overall UGs.

TABLE 1. Summary of Significant Correlation Values between Test Measures and Training Criteria

Test measure	Underway grades
PMT (error score)	
Stick-DLT	-.60*
Stick-rudder-throttle + DLT	-.54*
One-dimensional Compensatory Tracking	
CDOT	-.45*
CDOT + Digit Cancellation Composite	.34*
Digit Cancellation	.27

\* p < .05, two-tailed

The combined PMT/DLT (stick control) yielded the highest correlation with the UG ( $r = -.60$ ). This relationship was significant at the .001 level. The correlation ( $r = -.54$ ) between the PMT/DLT (stick, rudder, and throttle controls) composite and the UG was also significant at the .001 level.

#### One-dimensional Compensatory Tracking Digit Cancellation

The average cumulative distance off target (CDOT) error for the final three trials of the task was used because it was most

stable. Average CDOT error was  $M = 17.79$ ,  $SD = 5.79$  for those recommended for LCAC training ( $n = 36$ ), the average CDOT for those not recommended was  $M = 29.35$ ,  $SD = 10.16$  ( $n = 14$ ). The average CDOT difference between the two groups was significant ( $t = -5.07$ ,  $p < .001$ ). UG correlated significantly with average CDOT ( $r = -.45$ ,  $p < .01$ ). When the one-dimensional compensatory tracking task was performed in combination with the digit cancellation task, the correlation between their composite score and UG was  $r = .34$  ( $p < .05$ ). As can be seen by the results, the average CDOT and CDOT/digit cancellation composites correlated significantly with student UG during LCAC training.

The average number of digits cancelled in the Digit Cancellation task explained additional variance in the prediction equation and was used in the final selection system. The average digits cancelled for those recommended for LCAC training was  $M = 106.23$ ,  $SD = 20.31$  ( $n = 36$ ). The average digits cancelled for those not recommended for training was  $M = 78.59$ ,  $SD = 19.88$  ( $n = 14$ ). The difference between average digits cancelled for the two groups was significant ( $t = 4.35$ ,  $p < .001$ ). The correlation ( $r = .27$ ) between UG and the average digits cancelled was not significant at the .05 level.

#### Discussion

The psychomotor task performed in combination with the dichotic listening task was significantly related to the pass/fail criterion. These results provide support for the notion that certain abilities are useful in screening individuals for the LCAC training program.

Subjects who perform better (lower error score) on the multitask tests have a greater likelihood of success in the training syllabus. Taken together, these characteristics have proven to be reliable predictors of 1) those who will fail from training, and 2) actual LCAC performance in the primary portion of tactical, underway training. In these times of constrained military budgets, these variables may be crucial in reducing attrition from training.

The current findings support previous research in LCAC personnel selection (Dolgin and Nontasak, 1990) and corroborate a computer-based LCAC selection system. Continued research and evaluation of the valid tests in the battery and follow-up with the successfully screened LCAC-trainee population will provide insight into the long term value of the LCAC selection system in decreasing accidents and improving the quality of LCAC operators in the U.S. Navy.

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